VALIDITY OF THE 500 YARD SWIM AND 5 KILOMETER STATIONARY CYCLE RIDE AS INDICATORS OF AEROBIC FITNESS

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VALIDITY OF THE 500 YARD SWIM AND 5 KILOMETER STATIONARY CYCLE RIDE AS INDICATORS OF AEROBIC FITNESS

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Summary

A series of two studies were undertaken to determine the validity of including a 500 yard swim test or a 5 kilometer stationary cycle ride as the aerobic fitness measure in the current Navy Physical Readiness Test (PRT). In the first study, 60 healthy volunteers (29 male, 31 female) served as subjects. The aerobic fitness of each subject was determined from 1.5 mile run time and maximal oxygen uptake (VO_2max). Swimming skill, percent body fat, and 500 yard swim time were also measured. The results showed that 500 yard swim time did not correlate very well with either of the aerobic fitness measures (i.e., VO_2max or 1.5 mile run time). In fact, the most important determinant of swim performance appeared to be swimming skill ($r = -0.83$) and not maximal oxygen uptake ($r = -0.32$).

In the second study, a group of 20 healthy volunteers (9 male, 11 female) performed a series of 5 kilometer rides on a stationary cycle ergometer for time. In other words, they rode 5 kilometers as fast as they could on a stationary cycle. They also had their maximum oxygen uptake and 1.5 mile run times measured. The results showed that the cycle ergometer ride times were significantly correlated with the other aerobic fitness measures ($r = -0.72$ to $r = 0.94$).

It was concluded from the results of these two studies that factors other than aerobic fitness significantly affect 500 yard swim performance, and, therefore, its validity as a measure of aerobic fitness has to be seriously questioned. Its inclusion on the Navy PRT should be re-evaluated at this time, particularly if it is going to be used for job placement and evaluation. However, the validity of the 5 kilometer timed cycle ride as a measure of aerobic fitness was quite good. Since the cycle ride is easy to administer, requires minimal space to perform, and is non-weight bearing and, therefore, can be performed by many individuals who are medically exempt from the 1.5 mile run, it was recommended that it be included in the Navy PRT as an alternative to the 1.5 mile run.

Background

The Navy Physical Readiness Test (PRT) currently includes a 1.5 mile run for time as its indicator of aerobic fitness. However, there are several problems associated with the administration of this test. For example, not all individuals can participate in the running test due to medical problems. This concern is illustrated by one study (5), which found that 51% of the women and 29% of the men who enter the U.S. Army are injured during basic training. Furthermore, approximately 90% of the injuries were to the lower extremities (i.e., knees and ankles). Such injuries could preclude these individuals from participating in the 1.5 mile run.

Another problem associated with the 1.5 mile run is that enough space must be available for an accurately measured quarter mile track (i.e., approximately 130,000 sq. ft.). Such large space needs usually preclude the 1.5 mile run from being performed onboard ships or at inadequate recreation (i.e., training) facilities.

In light of the above problems this investigator was contracted to develop a set of standards for a 500 yard swim test (study 1) and a stationary cycle ergometer test (study 2) which could be substituted for the 1.5 mile run in the Navy PRT.

Methods

Study 1: The subjects for this study were 60 healthy volunteers (29 males, 31 females) who were recruited from San Diego State University. The mean ($\pm$ SD) age, height, and weight for the group was 24.7 $\pm$ 4.5 yrs., 173.3 $\pm$ 8.2 cm. and 67.4 $\pm$ 10.4 kg., respectively.

The majority of the subjects were recruited from the beginning, intermediate, and advanced swimming classes at San Diego State University. This was done to assure a wide spread of swimming skill and background in the subjects.

All subjects completed a health questionnaire (Appendix A) and signed an informed consent prior to testing. All sixty subjects performed each of the following five physiological tests.

1) Maximal oxygen uptake (VO_2max) was determined using an Alpha-Technology 4400 System as the subject performed a graded exercise test to exhaustion on a motor-driven treadmill. Heart rate was measured during the test using a CM-5 lead system. The following criteria were used to insure

that a maximal effort was acheived: RER greater than 1.0, HR greater than 90% age predicted (220-age) maximum, and less than a 150 ml difference in VO_2 for two consecutive 30-sec. gas collections (16).

2) 500-yard swim time was determined according to current Navy PRT protocol. This included having the subject swim 20 lengths of the S.D.S.U. 25-yd. swimming pool. Subjects were allowed to push off the side with feet and hands, but diving starts and racing flip turns were not allowed. The subjects used the front crawl stroke and were constantly reminded that this was a swim for time and that their object was to cover 500 yards as fast as possible. Time to swim 500 yards was recorded to the nearest second. Also, split time at each 50 yard interval was recorded, and stroke index (yards per swim stroke) was calculated for each subject for the first 50 yards of the swim test.

3) Run time for 1.5 miles was determined on each subject according to current Navy PRT protocol. This included having the subject run 6 laps of the S.D.S.U. 1/4 mile track. The subjects wore shorts or sweats and flat soled running shoes; no spikes were allowed. Time to run 1.5 miles was recorded to the nearest second.

4) Body composition was determined on each subject via hydrostatic weighing. The procedures of McArdle, Katch and Katch (11) were followed. Residual volume was measured, in duplicate, prior to hydrostatic weighing using the closed circuit oxygen dilution technique. Percent fat was calculated from body density using the Siri equation (15).

5) A quantative score of each subject's swimming skill was determined by direct observation and questionnaire. The rating instrument was developed by Dr. A. Osinski (S.D.S.U. Aquatic Program Director). A sample of the rating instrument, which is called the swimming skill index, is in Appendix B.

Study 2: The subjects for this study were 20 healthy volunteers (9 males, 11 females) who were recruited from S.D.S.U. The mean ($\pm$ SD) age, height, weight, maximum oxygen uptake, and % body fat for the group was 26.5 $\pm$ 4.8 yrs., 174.2 $\pm$ 10.5 cm., 68.6 $\pm$ 13.6 kg, 49.5 $\pm$ 11.1 ml/kg/min and 17.5 $\pm$ 7.3, respectively. All subjects completed a health questionnaire and signed an informed consent prior to testing.

All 20 subjects performed each of the following four physiological tests.

1) Maximal oxygen uptake was measured using procedures identical to those used in study 1.

2) 1.5 mile run time was measured using procedures identical to those used in study 1.

3) Each subject performed a series of four timed 5 kilometer (5K) rides on a Monark cycle ergometer (model 864). The resistance (kilopond) levels for each of the four rides were determined according to the following schedule:

Ride #1 = 0.5 kg per 15 kg of lean body mass
Ride #2 = 0.5 kg per 15 kg of body weight
Ride #3 = 0.5 kg per 20 kg of body weight
Ride #4 = 0.5 kg per 25 kg of body weight

For example, if a subject weighed 80 kg, the resistance for ride #3 would be set at 2 kg (80/20 x 0.5 = 2). The order of the four rides was randomly assigned. The subjects were allowed to vary their pace (revolutions per minute) during each ride. However, they were constantly reminded that they were being timed and that they were to finish the ride as quickly as possible. Time to complete the 5K ride was recorded to the nearest second. Each ride was preceeded by a two stage warm-up consisting of riding for two minutes at a resistance of 1 kg and one minute at the subject's designated resistance for that particular 5K ride. This was followed by two minutes of rest, after which the subject performed the ride. The 5K distance was measured on the cycle odometer.

4) Percent body fat and lean body mass were determined for each subject using the three site skinfold method of Jackson and Pollock (9). The lean body mass measure was used to determine the resistance setting for one of the 5K bike rides.

Results

Study 1. The important findings of this study can be summarized as follows:

1) The subjects that were recruited were quite heterogeneous on all measured variables. For example, the measured VO_2max ranged from 31.2 to 84.0 ml/kg/min. The 1.5 mile run time ranged from 7:06 to 21:19 minutes. These 1.5 mile times covered the full range of scores on the current Navy PRT classification table (7:06 min. = outstanding, 21:19 min. = below

minimum standard). The group also had a wide range of percent body fat (2.5% to 29.9%) and 500 yard swim time (6:20 min. to 18:31 min.). These swim times also covered the full range of possible classifications on the current Navy PRT classification table.

Thus, the goal of testing a sample of subjects with a wide range of values on measured variables was met. Also, from personal communication with investigators at the Naval Health Research Center (San Diego, CA), the sample in study 1 was considered to be similar in physical and physiological characteristics to the Navy test population.

2) The correlation coefficients for the three measured aerobic fitness tests (i.e., VO_2max, 1.5 mile run time and 500 yard swim time) are shown in Table 1.

Table 1

Correlation Coefficients Between the Three Measured Aerobic Fitness Variables

	VO_2max (ml/kg/min)	1.5 Mile Run Time (sec.)	500 Yard Swim Time (sec.)
VO_2max (ml/kg/min)	- - -	-0.84*	-0.32
1.5 Mile Run Time (sec.)	- - -	- - -	0.44*
500 Yd. Swim Time (sec.)	- - -	- - -	- - -

*$p < 0.01$, $N = 60$

As can be seen, there was a significant correlation between VO_2max and 1.5 mile run time [$r = -0.84$, standard error of estimate (S.E.E.) = 11%; VO_2(ml/kg/min) = -.06(1.5 mile run time in sec.) + 91.1]. Such a finding agrees with numerous previous studies (2,3,11). For example, Cooper (3) found that VO_2max and the 12 min run test had a correlation of $r = 0.89$ and a S.E.E. of 9%. Both the current study and previous works support the use of the distance runs to estimate aerobic fitness. However, Table 1 also reveals that 500 yard swim time was not significantly correlated with VO_2max [$r = -0.32$, S.E.E. = 18.9%; VO_2(ml/kg/min) = -.02(500 yard swim time in

sec.) + 64.9] and was only poorly correlated with 1.5 mile run time [r = 0.44, S.E.E. = 21%; 1.5 mile run(sec.) = .40(500 yd. swim time in sec.) + 423]. Such a finding seems to suggest that 500 yard swim time is not a good predictor of walk/run aerobic fitness. This finding agrees with the numerous studies that have examined the question of training specificity. For example, Holmer (7) studied two world class swimmers, three national (Sweden) level swimmers, and four subjects who were not swim trained during maximal tests on the bicycle ergometer, on the treadmill, and in the swimming flume. The results of this study demonstrated substantial differences in VO_2max, maximal heart rate, maximal ventilation, and maximal lactic acid between the three testing modes with the largest differences being seen in the non-swim trained group.

Magel, Foglia, McArdle, Gutin, Pecha and Katch (10) studied alterations in VO_2max with swim training (1 hr/day, 3 days/wk for 10 wks). Subjects performed maximal tests while treadmill running and tethered swimming, both before and after training. The initial VO_2max values while swimming were 15 percent lower than VO_2max running. Following 10 weeks of swim training, the swimming VO_2max increased by 11.2 percent, while the treadmill VO_2max increased by only 1.5 percent. Thus, swim training appears to increase swim performance much more than it increases absolute aerobic capacity.

Hartung (7) studied the heart rate responses of 10 highly trained swimmers at rest, during a standard treadmill walk and during the recovery period following the walk. The runners reached significantly longer endurance times to pre-selected heart rates of 110, 130, 150, and 170 beats/min than the swimmers, even though both groups were considered to be equally trained. The swimmers, in fact, performed no better on this test than a control group of untrained subjects, except at the heart rate of 130 beats/min. Obviously, the swimmers were highly trained, but they could not perform any better than the untrained group on a walk/run test. Pechar et al. (12) and Roberts and Alspaugh (13) reported similar results when comparing bicycle ergometer and treadmill training.

Lastly, Holmer and Astrand (8) studied two female identical twins who were both physically active, but one participated in hard swim training. The results showed that the twins were nearly identical in VO_2max when tested by treadmill running or by arm or arm plus leg cycling but differed considerably when tested under various conditions in the swimming flume.

All of the above mentioned studies and the current results (Table 1) support the hypothesis that factors other than just VO_2max significantly effect swim performance.

3) Since 500 yard swim time was so poorly correlated with VO_2max and 1.5 mile run time, it was decided to examine what other factors were important determinants in predicting swim performance. To do this a correlation matrix was generated looking at how VO_2max, percent body fat, swimming skill (as determined by the swimming skill index) and 500 yard swim time were related. This matrix is presented in Table 2.

Table 2

Correlation Coefficients Between VO_2max, % Body Fat, Swimming Skill, and 500 Yard Swim Time

	500 Yd. Swim Time (sec.)	VO_2max (ml/kg/min)	Swim Skill	% Body Fat
500 Yd. Swim Time (sec.)	- - -	-0.32	-0.83*	0.20
VO_2max (ml/kg/min)	- - -	- - -	0.28	-0.74*
Swim Skill	- - -	- - -	- - -	0.24
% Body Fat	- - -	- - -	- - -	- - -

*$p < 0.01$, $n = 60$

As can be seen, swimming skill was by far the best independent predictor of 500 yard swim time ($r = -0.83$). Next, a stepwise partial correlation was run on the above data. The results revealed that the partial correlation between 500 yard swim time and VO_2max was only -0.18 when swimming skill was controlled. Lastly, a multiple regression using stroke index as the swimming skill measure was performed. The independent variables were VO_2max, stroke index, and % body fat, while the dependent variable was 500 yard swim time. The multiple R was 0.67 ($n=49$, $p<0.01$). The regression equation was: Swim time = 1623 - 8.8 (VO_2max) - 222 (stroke index) - 5.8 (% fat). As can be seen, stroke index (i.e., swimming skill) is the most important variable in predicting 500 yard swim time. In fact,

swimming skill is approximately 25 times more important than VO_2max. Such a finding agrees with the results of Costill et al. (4) who reported that the best predictors of 400 yard swim time were lean body mass and stroke index. These results led Costill, Kovaleski, Porter, Kirwan, Fielding and King (4) to conclude that "there was little relationship between VO_2max and performance in the 400 yard swim." Interestingly, the data by Costill et al. (4) also showed that the recreational swimmers and the competitive swimmers in their study had almost identical VO_2max values (4.00 L/min. vs 4.04 L/min.), yet the mean 400 yard swim time for the two groups were significantly different (competitive group mean = 4:43 min. vs recreational group mean = 6:51 min). The above finding in combination with the results from the current study all suggest that swim performance is affected by several variables, the most important of which is probably swimming skill.

Study 2. The important findings of this study can be summarized as follows:

1) The correlation coefficients between the four timed 5K bike rides and the two established measures of aerobic fitness are shown in Table 3.

Table 3

Correlation Coefficients and Standard Errors of Estimate Between the Four Bike Rides and the Other Measures of Aerobic Fitness

	#1 Bike Ride (.5kg/15kg LBM)	#2 Bike Ride (.5kg/15kg BW)	#3 Bike Ride (.5kg/20kg BW)	#4 Bike Ride (.5kg/25kg BW)
VO_2max (ml/kg/min)	-0.73* ± 15.4%	-0.72* ± 15.6%	-0.78* ± 13.9%	-0.75* ± 15.0%
1.5 Mi. Run Time (sec.)	0.94* ± 9.5%	0.88* ± 13.4%	0.94* ± 10.1%	0.90* ± 12.3%

*$p < 0.01$, $N = 20$

As can be seen, all four timed bike rides were significantly correlated with both VO_2max and 1.5 mile run time. Furthermore, the relationships had standard error of estimates ranging between 9.5% to 15.6%. These S.E.E.s and correlation coefficients are comparable to those obtained from other indirect tests to estimate VO_2max (2,11). For example, in the classic work of Astrand and Ryhming (1) they reported that VO_2max could be estimated from

a sub-maximal heart rate at a set workload. Their nomogram had a S.E.E. of approximately 10%. More recently, Siconolfi, Cullinane, Carleton and Thompson (14) and Wilmore, Roby, Stanforth, Buono, Constable, Tsao and Lowdon (17) showed that sub-maximal cycle ergometer tests had correlations with VO_2max ranging from r = 0.77 to 0.94 and with S.E.E.s of approximately 12%.

Recommendations

The results from the two studies warrant the following recommendations.

1) It is felt that the Navy should question the rationale of including a 500 yard swim option in their PRT. If the rationale is to predict aerobic capacity for evaluation of job performance and placement, its inclusion must be re-evalauted. This conclusion is based on the fact that the content validity of the swim test as an accurate measure of VO_2max is quite poor. In fact, both the current results and previous studies have clearly shown that factors other than aerobic fitness, namely, swimming skill, are important determinants of 500 yard swim time. However, if the goal is to provide Navy personnel with standards to encourage their participation in activities to contribute to their physical fitness, its inclusion is recommended. To help encourage such participation, the investigator has developed a set of performance standards for the swim test that provide equivalence to the current 1.5 mile run times on the Navy PRT (OPNAVINST 6110.1C). This table is in Appendix C.

2) It is felt that the Navy should include a 5K timed cycle ergometer ride as an option in their PRT. This opinion is based on the following information. First, the content validity of the 5K timed bike ride appears to be quite high in regards to its ability to predict aerobic fitness. Second, the timed cycle test is easy to administer and its space needs are small. Also, the 5K cycle ride is non-weight bearing and, therefore, can probably be performed by many individuals who are currently medically excused from running. Furthermore, the skill necessary to pedal on a cycle ergometer is almost non-existent. Almost all individuals can easily learn to pedal the ergometer within seconds.

3) It is felt that there was no clear advantage in determining the resistance of the load for the cycle ride from either lean body weight or body weight and that equation #3 should be used (i.e., 0.5kg. load per 20

kg. of body weight). The regression equations for the recommended load are as follows: 1.5 mile time = 1.15 (5K bike time) + 39.7, and VO_2max = -0.06 (5K bike time) + 80.1. The investigator has developed a set of performance standards for the cycle ergometer test that provide equivalence to the current 1.5 mile run times on the Navy PRT (OPNAVINST 6110.1C). This table is in Appendix D.

4) Lastly, it is felt that the 5K cycle ride may be an excellent aerobic fitness measure for the Navy to adopt in their PRT. However, the results reported here are based on data from a relatively small sample (20 subjects). More data may be needed to support a decision to use the 5K ride in the Navy PRT.

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APPENDIX A

San Diego State University
Adult Fitness Program

Medical History / Health Habits Update

Name _____ Age _____ Date _____

Work Address _____ Phone _____

Home Address _____ Phone _____

Occupation _____

1. Hospitalization in the past year

Reason	Duration of Stay	Comments

2. List all medications presently taking

Medication	Purpose	Dose	How Often

3 Have you, in the past year, experienced any of the following? Indicate medical follow-up and comments when applicable.

		Medical Advice Was Sought (Please check)	Comments
	High Blood Pressure		
	Diabetes		
	Chest Discomfort		
	Rapid Heart Beats		
	Skipped Heart Beats		
	Musculoskeletal Problems		

4. Present Exercise Program

Type of Exercise	How Long (min)	How Often (days/week)	How Hard (training HR)

5. Present Smoking Habits

a. Do you smoke? _____ Yes _____ No

b. If so, what do you smoke? _____

c. How much? _____

6. Present Alcohol Consumption

a. Do you drink alcohol? _____ Yes _____ No

b. If so, what do you drink? _____

c. How much? _____ d. How often? _____

7. How many hours do you sleep each night? _____ Soundness of Sleep _____

8. a. Are the activities of your day stressful? Yes _____ No _____

b. How do you handle your stress? _____

9. List all the food you ate yesterday. (Please be honest.)

Food	Quantity	Food	Quantity

10. Which meals do you eat?

	daily	occasionally	never
Breakfast			
Early morning snack			
Lunch			
Afternoon Snack			
Dinner			
Bedtime Snack			

Signature _____ Date _____ Group _____

APPENDIX B

PERFORMANCE STANDARDS (SKILL): CRAWL STROKE

	SCORE
BODY POSITION 1. Deviates from horizontal. 2. May deviate slightly from horizontal. 3. Horizontal body position.	
ARMS 1. Occasional underwater recovery, nonrhythmic arm action, pull outside of shoulder width or across midline acceptable. 2. Elbow higher than hand in recovery. Entry in line with head and no wider than the shoulders. Arms alternate with near equal timing. 3. Smooth, continuous, rhythmic recovery. Relaxed wrist. Fingertips lead on recovery.	
LEGS 1. Occasional lifting of feet from the water ok. 2. Pumping action of the knees not acceptable. Six beat kick with occasional drag ok. 3. Flutter kick must be continuous & effective.	
BREATHING 1. Must breathe periodically without stopping. Head may be lifted to front or turned to side. 2. Must breathe every stroke. Head should rotate to side with some forward lifting acceptable. 3. Effective rhythmic or explosive breathing acceptable. Bilateral breathing ok.	
COORDINATION 1. Breathing and arm action not well coordinated. Some dragging of legs. 2. Breathing coordinated with arm action. Stroke coordinated and effective. 3. Well coordinated, balanced, smooth, and effective.	

TOTAL SCORE _____

(CIRCLE) ☐ BEGINNER

☐ INTERMEDIATE

☐ ADVANCED

SWIMMING COMPETENCY SCREENING TEST

	BEGINNER 1 PT.	INTERMED. 2 PTS.	ADVANCED 3 PTS.	SCORE
TREAD	2 MIN.	2 MIN WITHOUT USE OF HANDS	2 MIN HANDS HELD OUT WATER	
CERTIFICATION	NEVER TOOK FORMAL LESSONS	SOME SWIM LESSONS	ADVANCED CERT. (ALS, WSI...)	
SKILL	BEGINNER PERFORMANCE	INTERMED. PERFORMANCE	ADVANCED PERFORMANCE	
50 YD. SPLIT	>75 SEC.	45-75 SEC.	<45 SEC.	

TOTAL SCORE _____

Suggested 500 Yard Swim Times

NAVY PHYSICAL READINESS STANDARDS

	17-19 yrs.		20-29 yrs.		30-39 yrs.		40-49 yrs.		50 + yrs.	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
500 Yd. Swim										
Outstanding	8:46	9:58	8:53	9:58	9:15	10:13	9:22	10:20	9:37	10:34
Excellent	9:08	10:56	9:29	10:49	10:05	11:03	10:20	11:17	10:27	11:32
Good	9:44	11:39	10:13	11:39	11:03	11:53	11:25	12:15	11:46	12:29
Satisfactory	10:34	12:15	11:03	12:29	11:53	12:44	12:22	13:13	12:37	13:34

NOTE: These swim time standards were derived in the following manner:

a. A regression equation to predict swim time (sec) from 1.5-mile run time (sec) was developed [SWIM = .48(RUN) + 267.1]; (r = .44; SEE = 147.2 sec).

b. Using this equation, run time standards from OPNAVINST 6110.1C were converted to swim time standards.

APPENDIX D

Suggested 5-Kilometer Cycle Ergometer Ride Times at a Resistance of 0.5kg per 20kg of Body Weight

	17 - 19yrs		20 - 29yrs		30 - 39yrs		40 - 49yrs		50+ yrs	
	M	F	M	F	M	F	M	F	M	F
Outstanding	7:28	9:22	7:40	9:22	8:14	9:45	8:25	9:56	8:48	10:19
Excellent	8:02	10:53	8:37	10:42	9:34	11:05	9:56	11:28	10:08	11:50
Good	8:59	12:01	9:45	12:01	11:05	12:25	11:39	12:59	12:13	13:22
Satisfactory	10:19	12:59	11:05	13:22	12:25	13:44	13:10	14:30	13:33	15:04

NOTE: These cycle ride time standards were derived in the following manner:

a. A regression equation to predict bike time (sec) from 1.5-mile run time (sec) was developed [BIKE = .76(RUN) + 37.6]; (r = .94; SEE = 54.8 sec).

b. Using this equation, run time standards from OPNAVINST 6110.1C were converted to bike time standards.

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(U) VALIDITY OF THE 500 YARD SWIM AND 5 KILOMETER CYCLE RIDE AS INDICATORS OF AEROBIC FITNESS

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Two studies were performed, under contract, to determine the validity of including a 500-yard swim or a 5-kilometer stationary cycle ride as an aerobic fitness measure in the Navy's Physical Readiness Test (PRT). Participants in the swim test study were 60 college students (29 men and 31 women). The aerobic fitness of each subject was determined from 1.5-mile run time and maximal oxygen uptake (VO2max). Swimming skill, percent body fat, and 500-yard swim time were also measured. Results showed swim time to be weakly correlated with both run time and VO2max (r = .44 and -.32 respectively). Swimming skill was the primary determinant of swim time (r = -.83). In the second study, 20 college students (9 men and 11 women) performed a series of 5-kilometer rides on a stationary cycle ergometer for time. Maximum oxygen uptake and 1.5-mile run time were also measured. Cycle ride time was significantly correlated with both run time and VO2max (r = .94 and -.72 respectively). These results indicate that factors other than aerobic fitness (i.e., swimming skill) significantly affect 500-yard swim performance, and therefore, its validity as a measure of aerobic fitness has to be seriously questioned. Its inclusion in the Navy

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19. Abstract (continued)

PRT should be re-evaluated at this time, particularly if it is going to be used for job placement and evaluation. However, the validity of the 5-kilometer timed cycle ride as a measure of aerobic fitness is quite good. Since the cycle ride is easy to administer, requires minimal space to perform, and is non-weight bearing, and therefore can be performed by many individuals who are medically exempt from the 1.5-mile run, it is recommended that it be included in the Navy PRT as an alternative to the run. There is, however, a need to cross-validate the cycle test on a sample of Navy men and women.